Problems and prospects of functional nutrition in Russia: industry and social aspect

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Abstract. In recent years, great importance has been attached to the preservation and strengthening of public health, the role of disease prevention and the formation of a healthy lifestyle, including the formation of a culture of healthy nutrition of the population. Prolonged improper, irrational nutrition is a factor of increased risk of developing diseases: oncological diseases, alimentary risk factors of which are the presence of carcinogenic additives in food products; diseases of the cardiovascular system; obesity; disorders of the gastrointestinal tract due to the low content of dietary fiber in food; osteoporosis is a change in the composition of bones due to the loss of calcium. The analysis of the nutrition structure of the Russian population indicates significant deviations from the recommendations on rational norms of food consumption that meet modern requirements of a healthy diet. In this paper, a matrix method of developing a formula for a fermented milk product with a high protein content is considered by enriching yogurt with vegetable components: hemp flour, jerusalem artichoke syrup and agave syrup. Using the obtained recipes, samples of fermented milk products were prepared and tasting was carried out. According to the organoleptic results, the expediency of using the matrix method of computer modeling in the development of formulations of fermented milk products is confirmed. The resulting yogurts can be recommended for use by people with diabetes and those who lead a healthy lifestyle, because the protein content in the samples has been increased to 3.7% and the introduction of sugar is excluded.

1 Introduction

Nutrition is one of the main environmental factors that determine human health, normal growth and development, physical and mental performance, life expectancy, the body's

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resistance to infections and harmful environmental factors, and so on. Nutrition largely determines the indicators of quality of life and human health.

The science of nutrition is one of the most ancient, historically the basic "commandments" of nutrition have been formed: moderation, diversity, individuality, stability of the diet, preference for traditional nutrition.

The proposed "commandments" of nutrition, despite their apparent simplicity, provide the most complete and healthy nutrition without the use of any serious calculations.

Moderation in nutrition reduces excessive nutritional and metabolic load on the digestive system and the whole body, contributes to an increase in life expectancy, maintaining a higher quality of life.

The variety in the choice of food guarantees a balanced diet and avoids a shortage of certain nutrients.

Individuality in nutrition, taking into account food habits and preferences, coordinates nutrition with individual characteristics of the digestive and metabolic organs.

The stability of the diet ensures a stable, uninterrupted operation of the digestive system and the whole body, taking into account natural biological rhythms.

The preference for traditional nutrition is the choice of such healthy foods, for the processing and assimilation of which the body's enzyme systems are evolutionarily tuned and which minimize the immunological incompatibility of nutrients. Russia is ranked 42nd in the world in terms of food production per capita, while in 1997 it was ranked 7th. This is due to the fact that objective opportunities to produce high-quality products have decreased, a third of the acreage is not cultivated and food imports are growing. Compared with 1990, the import of meat increased almost five times, poultry meat — 28 times, milk — 3.2 times, fish — almost 20 times. As a result, the consumption of high-quality food has decreased [1].

The diet of a modern Russian is dominated by fats and sugar; vitamins and minerals, on the contrary, are not enough. Such nutrition leads to hypertension, atherosclerosis, diabetes, obesity. 50 percent of Russian adults are overweight [2].

The strategy of improving the quality of food products in the Russian Federation until 2030 is focused on ensuring proper nutrition, preventing diseases, increasing the duration and improving the quality of life of the population, stimulating the development of production and circulation in the food market [3].

When solving the problem of self-sufficiency of Russia with food, its priority types are highlighted: grain, sugar, vegetable oil, dairy and meat products, fish. Other types of food that are very important for ensuring proper nutrition: potatoes, vegetables, fruits, berries, eggs - are mainly the subject of regional self-sufficiency, and each of them in a particular region may have priority.

There are several aspects of food security. The first of them is global food security, which is characterized by a balance between world production and world consumption, and in a market economy — a balance between supply and demand, realized through the functioning of national, regional and world markets.

The second important aspect is the national problems of food security. In this aspect, food security can be considered as a system for maintaining the most important life support system - food, while keeping in mind the possible reliability of supply from external sources. National food security, as a rule, is based on the concept of self-sufficiency in basic types of food, as one of the components of economic security in general.

In the structure of nutrition of the Russian population, there is a decrease in the consumption of meat, dairy, fish products, vegetable oils, vegetables and fruits related to biologically valuable. At the same time, there was an increase in the consumption of bread products, bread, potatoes. The consequence of a violation of the structure of nutrition are nutritional status disorders: the deficiency of animal proteins reaches 15-20% of the recommended values, especially for low-income groups; pronounced deficiency of most

essential nutrients - polyunsaturated fatty acids, vitamins. Vitamin C deficiency is 70-100% in more than half of the population, folic acid and B vitamins - 60-80%, b-carotene - 40-60%. A serious problem is the lack of a number of minerals and trace elements (calcium, iron, iodine, zinc, selenium, fluorine). The shortage of dietary fiber is also significant in the diet of the population [4,5].

The leading in terms of the degree of negative impact on the health of the population is currently a deficiency of vitamins, trace elements, individual PUFA, which leads to a decrease in the body's resistance to adverse environmental factors, the development of immunodeficiency states, disruption of the functioning of the body's antioxidant defense systems. At the same time, the problem of overweight and obesity remains relevant for 55% of the adult population of Russia. The situation with regard to the provision of micronutrients to the Russian population is assessed as a crisis.

Despite the positive dynamics in the consumption of certain types of food products by the population of the Russian Federation, nutrition remains unbalanced. There is an excess in the consumption of sugar and confectionery products with a shortage in the diet of biologically valuable products such as vegetables, fruits, milk, eggs. Recently, the share of the population that began to use more meat products and sugar in their diet has increased by more than 2%, and the number of the population that does not use enough potatoes, eggs, vegetables, dairy products, fruits in their diet is more than 90%, which increases the risk to public health associated with unbalanced nutrition. More than 80% of the country's population has a protein intake deficit and excess fat intake (95.3%). The low level of carbohydrate consumption in the diets of the population of most subjects of the Russian Federation (96.0%) is primarily due to the insufficient use of vegetables and fruits in nutrition.

Prolonged improper, irrational nutrition is a factor of increased risk of developing diseases: oncological diseases (breast and gastrointestinal tract cancer), alimentary risk factors of which are the presence of carcinogenic additives in food products (nitrosamines, benz(a)pyrene, nitrates, etc.), increased salt and fat intake, as well as); diseases of the cardiovascular system that can be caused by high cholesterol in the blood; obesity caused by high fat intake against the background of low physical activity; disorders of the gastrointestinal tract due to low content of dietary fiber in foods; osteoporosis - a change in the composition of bones due to loss of calcium.

In recent years, in most countries of the world, much attention has been paid to proper nutrition, increasing the nutritional and biological value of food products of the population. The timeliness of food intake, its quality and quantity are among the basic components of a healthy lifestyle that affect the viability of a person. The observed decrease in life expectancy, an increase in morbidity and mortality of the Russian population is to some extent associated with a violation of the principles of healthy nutrition, deterioration of the balance and diet.

The main objectives of the Concept of Demographic Policy of the Russian Federation for the period up to 2025, approved by Decree of the President of the Russian Federation dated 09.12.2007 No. 1351, are to preserve and strengthen the health of the population, increase the duration of active life, create conditions and create motivation for a healthy lifestyle [6,7].

The main goals and objectives are: preservation and strengthening of public health; prevention of diseases caused by inadequate and unbalanced nutrition; expansion of domestic production of basic types of food raw materials and food products that meet modern quality and safety requirements; improvement of nutrition of various population groups, bringing the structure of nutrition of the population to the physiological needs of humans in nutrients and energy.

Organizational and practical work on the implementation of the Concept of state policy in the field of healthy nutrition of the Russian population is carried out in the following areas:
- implementation of monitoring of medical and social information on the state of nutrition and health of the population;

- reduction of micronutrient deficiency in the diet of the population;
- monitoring of food contamination;
- increasing the level of education of the population in matters of healthy nutrition with the broad involvement of the mass media.

At the same time, there are differences in food consumption between population groups depending on income. The nutritional structure of the population is characterized by insufficient consumption of biologically valuable food groups that are sources of protein, essential amino acids, trace elements.

The economic disadvantage of the population leads to the purchase of food products without taking into account their biological value. Dietary nutrition is practically absent. Dietary deviations in almost all population groups have an extremely negative impact on health – the average life expectancy is reduced, disease resistance and productivity of the able-bodied population are reduced, normal growth and development of children are disrupted.

One of the most important components in the diet of various groups of consumers is yogurt. The modern market of fermented milk products is represented by a wide range, among which the most significant place is occupied by products enriched with vegetable ingredients. The relevance of research and development in the field of technology for the production of innovative products is associated with the search for alternative sources of substances necessary for the human body. The joint use of dairy and vegetable raw materials in the production of fermented milk products makes it possible to obtain products with a given composition and the necessary physico-chemical properties. Thus, the demand of consumers for enriched dairy products is due to the fact that these products have a wider range of useful properties and are able to meet the body's need for the necessary nutrients [8,9,10].

The modern approach to the creation of functional food products is associated with the use of information computer technologies. The use of artificial intelligence in the design of fermented milk products makes it possible to solve prescription problems, i.e. to obtain a finished product with a given chemical composition and the necessary physico-chemical properties. This is due to the fact that computer technology allows you to quickly calculate the recipe with a large number of new types of ingredients [11,12, 13].

In this regard, the purpose of this work is to implement a matrix method for developing a formula for a fermented milk product with a high protein content, by enriching yogurt with hemp flour, jerusalem artichoke syrup and agave syrup.

The object of research in this work is selected drinking yoghurts, the production of which is carried out by the tank method. The choice of additives (hemp flour, jerusalem artichoke syrup, agave syrup) is due to the fact that hemp flour is a source of fiber, polyunsaturated fatty acids (the ratio of omega - 3 and omega - 6 is 1:3), vitamins C, K, E and macro- and micronutrients (Mg, Zn, Mn) [14]. Jerusalem artichoke syrup and agave syrup are useful sweeteners, contain a high content of fructose and glucose, which gives reason to recommend their inclusion in the diet of people with diabetes [15].

2 Materials and methods

The Russian Federation has developed rational norms for the consumption of food products that meet modern requirements of a healthy diet, necessary for an active and healthy lifestyle. The purpose of this development is to strengthen the health of children and adults, prevent non–communicable diseases, conditions caused by a lack of micronutrients, and improve the demographic situation in the Russian Federation.

The recommendations are designed for the population when forming individual diets and are not intended for catering in organized collectives. Unfortunately, minimum pensions and

salaries, as a rule, do not allow you to purchase a package of food that meets the recommended standards.

There is a clear understanding in the international scientific community that due to the growth of the Earth's population, which, according to scientists, should reach 9-11 billion people by 2050, it is necessary to double or even triple world agricultural production, which is impossible without the use of transgenic plants, the creation of which greatly accelerates the process of breeding cultivated plants, increases yields, reduces the cost of food, and also allows you to get plants with properties that cannot be obtained by traditional methods.

The food problem is not just a lack of food. The process of its production long before it reaches grocery stores causes many problems affecting the duration and quality of life on earth. Forests are being cut down to expand agricultural land, climate warming is taking place, biodiversity is being systematically reduced, mechanisms protecting humans from the negative effects of nature are being destroyed, soil and water are polluted, and plants and animals are being poisoned with various substances with questionable effect.

Currently, the main suppliers of agricultural products in the world are developing countries that are actively investing in this sector. World meat exports will grow by 19% by 2025, and the average annual growth rate will be 1.5%. Food prices will continue to rise. Food prices will also rise due to climate change, which leads to an increase in the number of weather anomalies, a jump in energy prices and general crisis uncertainty in the global economy. In the next decade, 25% of the currently used agricultural land will noticeably degrade.

When solving the problem of self-sufficiency of Russia with food, its priority types are highlighted: grain, sugar, vegetable oil, dairy and meat products, fish. Other types of food that are very important for ensuring proper nutrition: potatoes, vegetables, fruits, berries, eggs - are mainly the subject of regional self-sufficiency, and each of them in a particular region may have priority.

There are several aspects of food security. The first of them is global food security, which is characterized by a balance between world production and world consumption, and in a market economy — a balance between supply and demand, realized through the functioning of national, regional and world markets.

The second important aspect is the national problems of food security. In this aspect, food security can be considered as a system for maintaining the most important life support system - food, while keeping in mind the possible reliability of supply from external sources. National food security, as a rule, is based on the concept of self-sufficiency in basic types of food, as one of the components of economic security in general.

Optimization of the formulation composition of the fermented milk product enriched with plant components was carried out by the matrix method using the Excel program, using the search for solutions to nonlinear problems by the generalized lowering gradient method. An increased protein content in drinking yogurt was chosen as an optimization parameter. Therefore, to perform this task, additional criteria were introduced in the data matrix: calculation of energy value and the content of BZHU (per 100 grams).

Hemp flour, Jerusalem artichoke syrup and agave syrup were selected as vegetable ingredients in the design of the drink (Tables 1 and 2). Tables 1 and 2 also present a system of linear balance equations and constraints. The used information matrix of these formulations of enriched fermented milk products contained three elements: the type of ingredients; chemical composition; indexed variables (indicated in the tables by X_i).

3 Results

Table 1. Information matrix of data for prescription calculation of yogurt containing hemp flour and jerusalem artichoke syrup

Ingredients	X_i	Weight, kg	Mass fraction, %		
			Protein	Fat	Carbohydrates
Normalized milk	X_1	93,0	2,8	2,5	4,7
Skimmed milk powder	X_2	0,2	36,0	1,0	52,0
Sourdough	X_3	0,01	0,0	0,0	0,0
Hemp flour	X_4	1,8	30,0	7,9	24,7
Jerusalem artichoke syrup	X_5	5,0	0,0	0,0	65,5
Total		100,0			
Goal function			3,7		
Entering balance equations				2,5	9,8
Composition (g/100 g), caloric content, kcal/100g	76,5	60,6	3,7	2,5	9,8
Balance	Equations, constraints				
Protein	$F(x)=\max (2,8 \cdot X_1+36,0 \cdot X_2+0,0 \cdot X_3+30,0 \cdot X_4+0,0 \cdot X_5)$				
Fat	$(2,5 \cdot X_1+1,0 \cdot X_2+7,9 \cdot X_4)/100 \geq 2,5$				
Carbohydrates	$(4,7 \cdot X_1+52,0 \cdot X_2+24,7 \cdot X_4+65,5 \cdot X_5)/100 \geq 9,8$				
Yogurt weight	$X_1+X_2+X_3+X_4+X_5=100,0$				

Program calculation results: X_1=93,0; X_2=0,2; X_3=0,01; X_4=1,8; X_5=5,0. These results are listed in the table 1.

Table 2. Information matrix of data for prescription calculation of yogurt containing hemp flour, agave syrup

Ingredients	X_i	Weight, kg	Mass fraction, %		
			Protein	Fat	Carbohydrates
Normalized milk	X_1	93,2	2,8	2,5	4,7
Skimmed milk powder	X_2	0,2	36,0	1,0	52,0
Sourdough	X_3	0,01	0,0	0,0	0,0
Hemp flour	X_4	1,8	30,0	7,9	24,7
Agave syrup	X_5	4,8	0,0	0,0	78,0
Total		100,0			
Goal function			3,7		
Entering balance equations				2,5	10,2
Composition (g/100 g), caloric content, kcal/100g	78,1	60,6	3,7	2,5	10,2
Balance	Equations, constraints				
Protein	$F(x)=\max (2,8 \cdot X_1+36,0 \cdot X_2+0,0 \cdot X_3+30,0 \cdot X_4+0,0 \cdot X_5)$				
Fat	$(2,5 \cdot X_1+1,0 \cdot X_2+7,9 \cdot X_4)/100 \geq 2,5$				
Carbohydrates	$(4,7 \cdot X_1+52,0 \cdot X_2+24,7 \cdot X_4+78,0 \cdot X_5)/100 \geq 10,2$				
Yogurt weight	$X_1+X_2+X_3+X_4+X_5=100,0$				

Program calculation results: X_1=93,2; X_2=0,2; X_3=0,01; X_4=1,8; X_5=4,8. These results are listed in the table 2.

The development of formulations of fermented milk products with a high protein content, carried out by the matrix method, made it possible to establish optimal dosages of ingredients. Table 3 shows the compositions of the developed drinking yoghurts without taking into account losses per 100 kg of product.

4 Discussion of the results

The nutritional structure of the population is characterized by insufficient consumption of biologically valuable food groups that are sources of protein, essential amino acids, trace elements.

It is also worth paying attention to the availability and cost of healthy food, especially for low-income people. It is necessary to develop programs to stimulate the production and consumption of vegetables and fruits, as well as to organize local markets for agricultural products.

The economic disadvantage of the population leads to the purchase of food products without taking into account their biological value. Dietary nutrition is practically non-existent. Dietary deviations in almost all population groups have an extremely negative impact on health – the average life expectancy is reduced, disease resistance and productivity of the able-bodied population are reduced, normal growth and development of children are disrupted.

Table 3. Optimized compositions of the projected drinking yoghurts

Ingredient	Enriched yogurt recipe, raw material consumption 100 kg excluding losses, kg	
	Sample 2	Sample 3
Normalized milk	93,0	93,2
Skimmed milk powder	0,2	0,2
Sourdough	0,01	0,01
Hemp flour	1,8	1,8
Jerusalem artichoke syrup	5,0	-
Agave syrup	-	4,8
Total	100,0	100,0

Based on the calculated data obtained from the developed recipes, samples of drinking yoghurts were prepared and their organoleptic parameters were determined. Preparation of samples was carried out according to traditional technology (reservoir method), which consists of the following stages: normalization and pasteurization of milk; introduction of dry sourdough "Skvaska", consisting of Streptococcus thermophiles and Lactobacillus bulgaricus; thermostating for 7-8 hours at a temperature of 37 ° C; cooling and mixing until the homogeneity of the clot; addition of vegetable ingredients; packing in an airtight container.

The organoleptic parameters of the samples were evaluated according to GOST R ISO 22935-2011 and GOST R ISO 22935-3-2011. Classic yogurt without the addition of vegetable ingredients was selected as a control sample.

During the tasting, the following parameters were evaluated: consistency, appearance, smell, taste and color, on a 5-point scale, where 5 is a product without deviations from the stated requirements, 1 is very significant deviations.

The obtained samples had a homogeneous consistency, the presence of insoluble particles of hemp flour was observed, which corresponded to the parameters specified in Table 4. In this regard, all samples received the highest rating – 5. The color when adding jerusalem artichoke syrup and agave syrup changed, acquiring a shade corresponding to the color of the syrups being injected. When assessing the taste qualities of the product, the sample with agave syrup had a more interesting and unusual taste, so a score of 5.0 points was given. It is also worth noting that the developed samples will be in great demand among consumers with diabetes mellitus and among those who lead a healthy lifestyle, since the protein content in the samples has been increased to 3.7% and the introduction of sugar is excluded.

Priority tasks in this area are: assessment of the structure of nutrition, its impact on health, rationalization of nutrition, including regular supply of the body with all necessary vitamins and minerals; control over the safety of food raw materials and food products at the stages of production, transportation, storage, sale, consumption, which is necessary for the prevention of infectious and mass non-communicable diseases related to nutrition.

5 Conclusions

Preserving the health of the population of the Russian Federation is a priority task of the state. Nutrition is one of the most important factors determining the health of the population. Proper nutrition ensures the normal growth and development of children and adults, contributes to the prevention of diseases, prolonging people's lives, improving working capacity and creates conditions for their adequate adaptation to the environment. At the same time, the basis for promoting a healthy lifestyle should be, among other things, informing about the dangers of irrational and unbalanced nutrition and training in the skills of observing the regime and structure of nutrition. Using the matrix method of computer modeling, formulations of fermented milk products enriched with hemp flour, jerusalem artichoke syrup and agave syrup were obtained. Organoleptic studies confirm the expediency of using this method in the development of formulations of fermented milk products.

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